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AIR UNIVERSITY

THE TRANSITION TO A SPACE AND AIR FORCE

PROPOSED SOLUTIONS TO THE DILEMMA

by

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War will someday occur in space. History supports the argument that humans have never encountered a medium they could occupy without fighting wars in it for one reason or another. Space will be no different. Who will reign supreme in this new medium of warfare? The Air Force has laid claim to the role of superior military force in space by committing to a transition from an air force to an air and space force on an evolutionary path to a space and air force. First, however, the Air Force must solve significant problems in doctrine, leadership, technology and funding. This paper addresses each of these areas, identifying weaknesses and proposing solutions in each area. Doctrine must address the unique characteristics of the space medium and commit to establishing an offensive space-based capability. The Air Force has not prepared enough officers experienced in space operations to serve at the flag rank, and that record must be reversed. Several key enabling technologies must be pursued, but none more than those providing assured, affordable access to space. Finally, the Air Force must take the lead in restructuring existing forces, recognizing the potential offensive capability of space-based systems, and seeking a $30 billion annual increase in space spending by 2005. If the Air Force acts on these recommendations, it will ensure its transition to a space and air force is accomplished successfully and in time to prepare for eventual conflict in space.

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Contents

Page

Illustrations

Page

Preface

Space: sanctuary or battleground of the future. This issue is charged with a great deal of emotion on all sides and, in its extreme could well determine the fate of the United States. If one accepts the premise that mankind will eventually wage war in and from space, then the nation is faced with the obvious questions about who will prevail, how and at what cost. This paper asserts that war will occur in space and that the United States should take necessary steps now to ensure it wins when it does—those steps are the Air Force's first in its transition to a space and air force.

I owe a great deal of gratitude to many people for their invaluable assistance in the preparation of this work. Colonel Chuck Thompson provided guidance as well a significant amount of research material he has collected in his three years as the Air War College Space Chair. Mr. Carl Builder took time to respond to frantic E-mail searches for ideas and provided his usual "right on target" insight. Several valued friends volunteered to act as an "outside advisory group" and provided many hours of editing, guidance, ideas, and "murder boarding" for my often vectorless ramblings. To those wonderful people—Arnie Berry, Jim LaFrieda, Steve Stadler, Rick Strathearn, Steve Canzano—I am eternally grateful. I owe a ton of gratitude in particular to Juice Jensen, whose decade-long mentorship goes well beyond this research effort. Critical insight into some of the issues explored here was provided by Lt Gen Roger DeKok and Maj Gen Robert Dickman, two men who have been fighting the battles for recognition and use of

space systems with distinction for more than twenty years. Without all the above help, I am certain I would still be lost in a futile search for a meaningful opening statement. Finally, to my most valued friend and Air Force colleague, Lt Col Terry Clark whose insight into space issues has been a source of inspiration and a sounding board for often vigorous debate in our shared household for 18 years.

Abstract

War will someday occur in space. History supports the argument that humans have never encountered a medium they could occupy without fighting wars in it for one reason or another. Space will be no different. Who will reign supreme in this new medium of warfare? The Air Force has laid claim to the role of superior military force in space by committing to a transition from an air force to an air and space force on an evolutionary path to a space and air force. First, however, the Air Force must solve significant problems in doctrine, leadership, technology and funding. This paper addresses each of these areas, identifying weaknesses and proposing solutions in each area. Doctrine must address the unique characteristics of the space medium and commit to establishing an offensive space-based capability. The Air Force has not prepared enough officers experienced in space operations to serve at the flag rank, and that record must be reversed. Several key enabling technologies must be pursued, but none more than those providing assured, affordable access to space. Finally, the Air Force must take the lead in restructuring existing forces, recognizing the potential offensive capability of space-based systems, and seeking a $30 billion annual increase in space spending by 2005. If the Air Force acts on these recommendations, it will ensure its transition to a space and air force is accomplished successfully and in time to prepare for eventual conflict in space.

Chapter 1

Doctrine

As one veteran Israeli pilot said after the June 1982 air campaign over Lebanon in response to American questions about how much doctrine the Israeli Air Force had written down, "Yes, we have books. But they are very thin."

—Barry D. Watts and James O. Hale
Air University Review, 1984

Introduction

The world has changed dramatically in the past ten years. On that point there is almost universal agreement. The cold war is over, the wall is down, Europe is back on track with its integration effort, the information age has moved to the forefront of technological innovation, national defense strategy has taken a regional focus on less than general war conditions, and the United States Air Force has declared itself to be in a transition from an air force to an *air and space force* en route to a *space and air force.*[1] Little agreement exists, however, on exactly how the United States should respond to this changed, and still changing, world.

In particular, the specific role of the military, their makeup and mix of forces and their organization is undergoing strenuous debate at all levels with little hope of a definitive solution in the near future. The ongoing Quadrennial Defense Review (QDR)

could answer the most pressing questions on the future shape and role of military forces, but most senior leadership privately hold little hope for meaningful results from QDR. The Air Force, along with all the other services, is concerned about its future and specifically the future role of airpower in a multipolar, regional, military operations-other-than-war (MOOTW) environment. It is that concern coupled with some true vision on the part of many Air Force leaders that led to the historically significant "transition" statement from Chief of Staff General Ronald Fogleman and Secretary of the Air Force Sheila Widnall.

This transition commitment has generated much talk about air and space power and air and space superiority. What is missing, however, are answers to several obvious and significant questions:

1. *What, exactly, does this transition mean?*
2. *How will the Air Force make this transition?*
3. *Why is the Air Force making this transition?*
4. *When will the Air Force begin this transition?*
5. *How will the Air Force know when it is complete?*
6. *What investments are necessary?*
7. *What are the investment priorities?*
8. *How will the United States pay for these investments?*

The Air Force could find itself continuing to struggle for years to come in its efforts to answer these and many other questions concerning its future. There are several reasons for this inability to reach consensus quickly.

First, the global geopolitical picture is unclear and easy answers to most security and defense questions simply do not exist. Second, in an unstable fiscal environment, long term commitments to new investments are nearly impossible to make wisely. Third, technological advances, especially in computers and the closely related information

gathering, processing and dissemination realm, are so rapid as to render yesterday's solutions obsolete by tomorrow. Finally, but certainly not the final factor, the Air Force finds itself unprepared in four important areas to successfully embark on the transition path to a space and air force—those areas are doctrine, space leadership, access to space and funding.

Little can be done in this paper to address all the conditions contributing to uncertainty in the Air Force dilemma, although specific technology, leadership and budget issues will be discussed later, but recommendations in areas the Air Force can and must influence are covered here on doctrine and the next chapter on leadership.

What is Doctrine?

Formalized doctrine is an important link to what has been done in the past and what will be done in the future. Doctrine teaches the things the military needs to know in order to avoid past mistakes; and it provides the basis for organizing, training and equipping forces to fight and win future wars. Past and current Air Force attempts to doctrinally guide the development of a fully capable and operationally responsive space force structure have been unsuccessful. The United States cannot claim an adequate space launch capability after 40 years of launch operations. Sister services who depend on space-based combat support systems do not trust the Air Force to satisfy their requirements.[2] The result is disagreement over space issues at the service level, the resulting waste of scarce resources, and an undesirable trend toward Department of Defense (DOD) vice service management of space programs.[3] These conditions exist because adequate space doctrine never has.

Air Force Chief of Staff, General Ronald Fogleman, has suggested two key fundamental ideas which cannot be disregarded: space is the fourth dimension of warfare and the Air Force is in transition from an air force to a space and air force. The Air Force must develop adequate doctrine to support this transition into the fourth medium. If not, it may well find itself trying to fly long range unescorted strategic daylight precision bombing missions all over again.[4]

The Air Force receives significant criticism areas concerning its lack of understanding, development and statement of doctrine. Critics in the Army will say, unofficially at least, that the Air Force simply has no doctrine. Navy friends have jokingly remarked that the Air Force is not old enough to have an experience base sufficient to establish clear doctrine, that the Air Force "doesn't have tradition, only habits."[5] While these observations may be presented in the context of friendly interservice rivalry, there is some basis for concern if only from the old adage that humor is often derived from fact. Within the Air Force, there is concern over doctrine, or the lack of an adequate Air Force doctrine, underscored by the recent creation of an Air Force Doctrine Center to address service doctrinal issues. This center, ordered by the Chief of Staff, will begin its work in the spring of 1997 at Maxwell Air Force Base in Alabama. General Fogleman has stated "The current Chairman of the Joint Chiefs has taken the approach that joint doctrine will flow from Service doctrine. Therefore, we Services have got to have our act together."[6] Clearly, Air Force leadership believes it can and must improve its doctrine. Perhaps the lack of a complete understanding of doctrine could be blamed for an apparent lack of effective Air Force doctrine.

The word "doctrine" is derived from the Latin "*doctrina*" and "*doctor*" meaning teacher. In the military, we establish certain principles based on lessons learned from our warfighting, training and technology development experiences and call it doctrine. Doctrine, therefore, could be viewed as the military's teacher, a clearly written, easy to understand and follow, guide to preparation for conflict. According to some strategists, doctrine tells us how best to use military forces to achieve national security objectives. General Fogleman supports this approach when he contends that

> . . . its (doctrine's) primary purpose should be to guide warfighting and military operations other than war. Air Force doctrine should provide an integrating framework that ties together the various elements of the Air Force team; to show how these elements work together; and to provide a basis for integrating air power with other forms of combat power in joint operations. The ultimate goal of our doctrine should be the development of an airman's perspective on joint warfare and national security issues.[7]

Another approach to understanding the role of doctrine is to examine the link between military doctrine and national security. An acceptable baseline for this analysis is Professor William Snyder's strategy model. Linking key high level factors, Professor Snyder contends "strategy is a broad concept, embracing an objective, resources, and a plan for using those resources to achieve the objective."[8] If one accepts an Air War College premise that doctrine is the basis for organizing, training and equipping forces[9], in other words, providing those resources in Professor Snyder's model, a link between military doctrine and the projection of power in support of national security objectives easily follows.

Combining these two approaches produces a model shown below in Figure 1 that links all the key elements of national security and places doctrine in a clear position of influence over strategy and resources at the proper points in the process. Adoption of this

model could help clarify the exact role of doctrine and where it fits in the national security process. Once this, or another suitable model, is adopted for widespread use, Air Force doctrine should begin to take useful shape and allow the Air Force to answer the crucial questions listed earlier regarding its future direction and role.

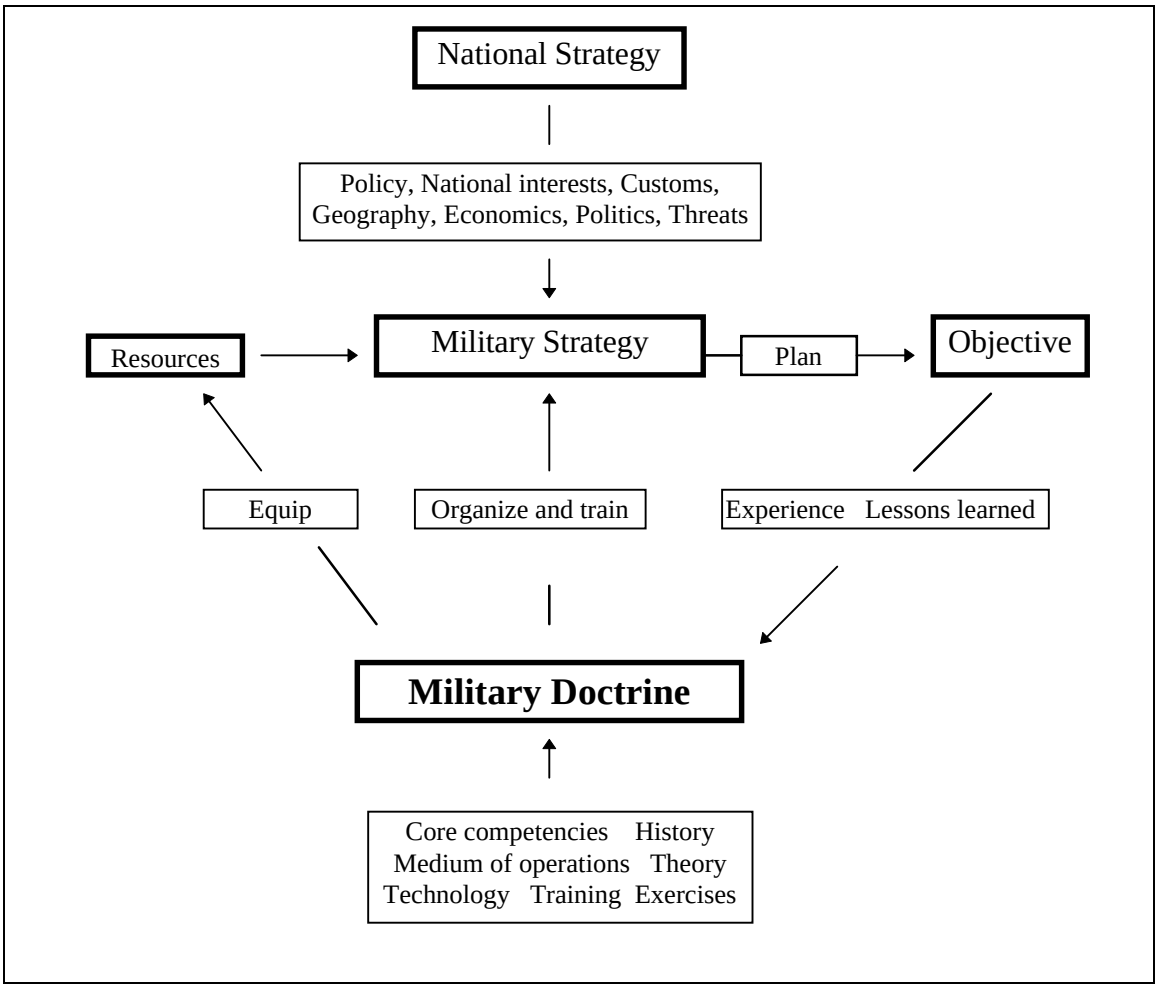

Figure 1. A Doctrine Model

Current Air Force Space Doctrine

> *Few people who know the work of Langley, Lilienthal, Pilcher, Maxim and Chanute but will be inclined to believe that long before the year 2000 A.D., and very probably before 1950, a successful aeroplane will have soared and come home safe and sound.*
>
> —H. G. Wells, 1901

Soon after the Wright brothers successfully made their first flight at Kitty Hawk on December 17, 1903 , air enthusiasts Douhet, Mitchell and others recognized the military applications of this revolutionary machine and attempted to lay down certain guidelines for its employment in battle—the birth of today's airpower doctrine. Likewise, the Soviet Union's October 4, 1957 launch of Sputnik 1 ushered man into the "fourth dimension of warfare"[10] and began the debate over space doctrine that continues today.

Air Force attempts to establish effective space doctrine have met with little success since the dawn of the space age. One consistent ingredient, however, has been the internal criticism generated by past doctrine documents[11], criticism from Air Force people that has spanned a number of years.[12] Several efforts[13] dating back to 1959 have proved inadequate, thus providing no enduring foundation upon which the Air Force could construct a viable warfighting space force. The following analysis of two current documents addressing space doctrine, Air Force Manual (AFM) 1-1 and AFDD 4 (draft), is an attempt to focus the doctrine debate in the right areas of emphasis for military space doctrine.

Critical study of the documents cited above, based on the Chief of Staff's statement that the primary purpose of doctrine should be to guide warfighting, reveals that Air Force endeavors to establish doctrine for space, and, more specifically space warfare,

have been serious failures. Not only are the unique aspects of the space medium excluded, the real issues of how to organize, train, and equip forces to fight and win war in and from space are avoided completely.

AFM 1-1

Paragraph 1-6a of AFM 1-1 points out "services are organized under three departments, generally along the lines of mediums of warfare: air, land, and sea." Even though space is conspicuous by its absence here, General Fogleman has recently suggested that space is the fourth dimension of warfare and it is not illogical to presume that it is the fourth medium as well.[14] The Air Force has no clear space doctrine in large part due to the failure of current Air Force doctrine to recognize space as a separate and distinct warfighting medium.

AFM 1-1 states that air and space are inseparable, that "no absolute boundary exists" between air and space, thus establishing the principle that the aerospace (air and space) medium is one and the same. Boundaries—both political and natural—do in fact exist, however. From a political perspective, one simply has to examine recent tactical battle plans the Air Force was forced to abandon because certain countries would not grant basing and overflight permission, as acknowledged in paragraph 2-1b of AFM 1-1.

Although no clear line of separation has been established as the physical boundary between air and space,[15] an intuitive argument would support the fact that one does exist. Suppose, for example, that an F-15 were to climb through the aerospace medium until its engine flamed out due to a lack of air, the pilot would have surely discovered the second of current doctrine's non-existent boundaries between air and space. An obvious counter argument is that this condition is technology limited and that future breakthroughs in

aerospace plane and single-stage-to-orbit efforts will solve the seamless aerospace medium dilemma in current doctrine. While that is certainly true for the travel portion of aerospace flight, it still does not address the fact that operations in the two media are quite different.

Operations in air and space are different in many physical ways, evidenced by the existence of two different sets of rules governing movement within them—aerodynamics and astrodynamics. As a result, the two media are distinct in their ability to host operational platforms, complete with different performance characteristics, survivability requirements for man and machine, unique basing, maintenance, sparing, fueling and capability potential, to name only a few. In spite of the fact that the Air Force has chosen to minimize the differences between the air and space media, efforts have been made to construct an operational space doctrine

AFDD-4

Space operations are addressed in AFDD 4 (draft). As promising as it is, if one accepts the premise that doctrine guides the organize-train-equip functions in order to prepare forces for future conflicts, the document also fails in its most basic purpose. Should the Air Force follow the doctrinal guidelines in AFDD 4, it will succeed only in maintaining the status quo in current space capabilities, basically that of a supporting force. Simply supporting other forces from space will not be sufficient as more and more potential adversaries gain access to space assets and more of the nation's military capability moves to space. While serving to represent an acceptable doctrinal baseline for existing space mission areas, AFDD 4 does not adequately address the essential missing piece of total space capability, namely force projection from space.

For example, AFDD 4 states when used properly, space forces "are a significant force multiplier for terrestrial forces." While this statement is certainly true and important, following this line of thinking alone will doctrinally lock space forces forever in the support box. The Air Force misses the mark by failing to stress the one mission area military thinkers are professionally bound to pursue to conclusion—the destruction of opposing forces. Further, the document completely ignores the subject of force projection in and from space as it describes the five purposes of offensive counterspace on page 6:

> **deception**—manipulate, distort, falsify
> **disruption**—jam, withhold data
> **denial**—deny electric power to ground nodes and computer centers
> **degradation**—attacks against terrestrial elements
> **destruction**—SOF to interdict ground nodes, airpower to bomb facilities and attacks against mobile space elements.

AFDD-4 includes a sparse ten-line discussion on the application of force and allows that ". . . technology and national policy could change so that force application missions can be performed from platforms operating in space." Doctrinally this position is well short of that needed to prepare the United States for future conflict. While it may be acceptable for others to side step the issue and claim space as a sanctuary, it is a basic military function to think about and plan for those military activities it believes necessary to ensure continued superiority on every battlefield. In AFDD 4 the Air Force has missed another opportunity to clearly express exactly how we intend to fight and win in and from space.

Finally, AFDD-4 includes less than a single page on training and education of the next generation in what is most likely the future preeminent Air Force mission. In short,

current doctrine recommends that commanders send some of their troops to a short course offered at the Space Warfare Center or to those offered by Air Education and Training Command (AETC). Although these courses are fine products put together by a dedicated team of young space pioneers and warfighters from every service, they are not enough to prepare future "brilliant warriors." A much more meaningful commitment to education would include:

1. A fully staffed Space Department at Air University (AU) to serve Officer Training School (OTS), Squadron Officers School (SOS), Air Command and Staff College (ACSC), Air War College (AWC), and Non Commissioned Officer Professional Military Education (NCO PME) through the development and administration of a robust space education program.
2. A thoroughly integrated, full spectrum space curriculum at the Air Force Academy.
3. A well developed Space Masters and Doctorate program at selected universities with a combined enrollment of 75-100 students in grades from captain through colonel in attendance at all times.
4. Wargame models and engines that clearly demonstrate the military utility of current space systems across the full spectrum of conflict. Additional models must be developed that provide data for detailed cost and operations analysis of proposed space systems, including based weapons. Finally, appropriate operational models must be developed and fully integrated into planned battle labs and joint wargaming facilities.

Proposed Tenets for Space Doctrine.

Eventually, and no one can accurately predict when, the United States will face a peer competitor in space or be forced to defend its commercial and/or military space assets. Humans have yet to encounter a medium they could travel and occupy without eventually developing the ability to conduct commercial enterprise and to wage war in that medium. Space will be no different. Thousands of years of recorded history offers ample testimony and support for this argument. The United States must be first to master the ultimate high ground if it is to survive as the preeminent power among nations and

succeed in its most basic national security objective: to preserve its way of life. It follows logically that if the United States is to be first to achieve and maintain dominance in the medium of space, it must begin by developing an appropriate doctrine and then organizing, training and equipping its military forces based on that doctrine. This is uniquely an Air Force challenge.

Using the model shown above in figure 1, the new Air Force Doctrine Center should address space doctrine development as one of its priority efforts. The following proposed tenets are certainly not all inclusive, but they do offer an excellent starting point for space doctrine development:

Capabilities and characteristics. Space systems should be smaller, lighter, more maneuverable, more survivable, more knowledgeable, more precise, more lethal and, at the same time, more humane. Weapons should be "one shot–one kill" capable while minimizing collateral damage. Space systems must be able to both support and participate in the full range of conflict from peace keeping and counter terrorism through general war. Space systems should team with terrestrial systems to "sniff, find and kill" weapons of mass destruction (WMD) including nuclear, chemical and biological (NBC) targets. Space systems must be capable of finding, tracking and neutralizing individual targets, either mechanical or human, alone and in conjunction with ground based forces.

Space systems are joint assets. Space forces must be capable of operating independently or in concert with all air, land and sea forces. In terrestrial operations, space forces are more effective when teamed with terrestrial forces.

Space is a unique medium. Although a close neighbor to the air medium of operations, space is different. Access, maneuver, natural threats, survivability,

operations, logistics, force projection, strategy, tactics, techniques and procedures may require systems and solutions not applicable to other operating media.

Space is very large. Space is the only operating medium that is infinitely unbounded. The operational sphere below geosynchronous altitudes, a very small portion of the potential near term operating region, is 50 billion times larger than the total air bubble surrounding earth.[16] This vastness of space must be thoroughly understood and exploited.

The principles of war apply to space forces. Until learned from experience or proven otherwise, there is no reason to deviate from currently accepted principles of war.

Space has its own high ground. US forces must find and eventually occupy and/or control key locations in space, for example, the LaGrange points.[17]

Space professionals must know the environment. The space environment is not well understood. US forces must have superior knowledge of the space environment in order to survive its hostilities and exploit its characteristics. Success or failure could well depend on who has the better understanding, and makes the best use of, the space environment. Whenever feasible, every orbiting space system should include a suite of space environmental monitoring sensors. All possible data must be gathered, processed and distributed to planners; system designers and developers; and operational tactics, techniques and procedures development teams in useful information format.

Not every "space system" belongs in the Air Force. The Air Force is the preeminent service for buying, building and operating space-based forces. Air Force emphasis should be on airplanes and orbiting platforms operated to achieve Air Force missions and to support terrestrial forces. Land and naval forces should be afforded maximum opportunity to operate terrestrial-based portions of space systems. In addition, they should buy,

develop and operate force-specific user equipment and defense systems that are not space-based. These systems must be interoperable to ensure maximum performance in joint and combined operations.

Space-based systems should be tested first on airframes. Whenever possible and feasible, systems being developed for on-orbit operations should be considered for initial testing on airframes, either manned or unmanned, as a natural transition from concept to reality. A current example is the YAL-1A, airborne laser. This process will permit more economical concept exploration, tactics and techniques definition, and field new capabilities more quickly. This development concept will promote the search for smaller components, providing benefits in launch cost reductions and related technologies for more portable terrestrial systems.

Space is not a sanctuary. In spite of the attractiveness of much intellectual debate, the space sanctuary genie was let out of the bottle on 4 October 1957. As commercial investment and presence in space increases, so will the need to provide security for space-based systems. Increased reliance by military terrestrial forces on space systems dictates their defense. Soon, all unified and specified commands except European Command (EUCOM) will be based in the continental United States (CONUS). When required, they will deploy forward and leave and leave some key functions behind and depend on robust communications. Intelligence data bases and logistics support management are but two examples. The Navy now steams in spread formations so large, line-of-sight communications are inadequate to coordinate movement, thus satellite communications are critical. Eventually, nearly all military and civilian navigation functions will rely on space based position and time transfer system such as today's Global Positioning System (GPS).

Those assets must be protected. Civilian security, military defense, or both will be developed and must be coordinated.

Perspective. Global perspective from space offers advantages available from no other high ground. When teamed with appropriate terrestrial forces, total global awareness will be achievable. Space-based systems will provide hyperspectral, nearly all-band wide area surveillance against nearly all target sets. Although reconnaissance capability will be available, adequate theater, regional and spot reconnaissance will require cooperative air breathing platforms and human intelligence assets.

Presence. Robust low earth orbit (LEO) and properly positioned geosynchronous earth orbit (GEO) systems will provide full time, all weather continuous global presence, a unique aspect of space-based systems. Basing and overflight[18] are not a limiting factor.

Responsive. Space-based systems are "in theater" and ready to respond instantly. No other option offers the opportunity to gather data constantly, be "virtually present" around the globe in all weather and at all times, and to respond instantly with deadly, precise power against the full spectrum of targets.

Weapons in space. The Air Force will build and operate on-orbit weapons. Priority for development and deployment are: first, defensive systems; followed by force protection systems; and, finally, force projection capability to engage targets in space, in the air, on land, on and under the sea.

Space-based systems should replace, not add to, existing force structure. There is no near term pressing need to develop the capability to kill tanks, sink ships or down aircraft from space-based platforms; the US has adequate capability in this area for the foreseeable future. Should another country enjoy an enabling technological breakthrough, for

instance, in its air-breathing capability, this tenet of space doctrine should change to reflect the new threats.

Near-term investment priorities. New space investment should be directed first at providing capabilities that do not currently exist elsewhere. Examples are global awareness, mobile target detection and targeting, information related systems, boost phase missile defense, and defensive systems for US space-based assets. The second priority should be to replace aging air-breathing systems with more capable space-based systems, for example Airborne Warning and Control System (AWACS), Joint Surveillance and Target Attack Radar System (JSTARS), and AC-130 gunships.[19] Finally, the US should transition core Air Force "shooter" missions, such as air superiority, interdiction and strategic bombing, to space-based platforms as existing systems age and retire from the force.

Leadership for operations of space-based systems must be selected from a cadre of properly prepared space experienced airmen. The best leaders for space systems will be trained and experienced airmen with a concentration of assignments in space operations and related functional activities.

Education for space leaders is essential. All professional military education programs must include a wide variety of courses relative to pressing current and future space issues. Graduate and post graduate education in space related disciplines must be available to and encouraged for all officers, and undergraduate programs in similar disciplines should be available to noncommissioned officers.

Routine access to space is the first priority. Space lift and travel must be made an "airplane-like" operation. All else depends on affordable, dependable, responsive access to space.[20]

Summary

Solving the doctrine dilemma is a high priority issue for the Air Force and critical to the development of combat capable space forces. Hopefully, the above discussion will be a positive addition to the ongoing debate over space doctrine. Key elements of future space doctrine must include, as a minimum, the importance of access to space, the potential of space for force projection, the unique characteristics of space as an operating medium, the requirement to fully understand those characteristics, the principle of joint and combined operations and the need to educate future space warriors to unprecedented levels. If the Air Force begins its transition to a space and air force with these vectors, all the other important steps will naturally occur.

Unfortunately, doctrine is not the only pressing issue—organization and leadership development, enabling technologies and cost all require equal serious study and debate, near term decisions and aggressive action.

Notes

[1] Department of the Air Force, Washington, DC, "Global Engagement: A Vision for the 21st Century Air Force," released 21 November 1996, 7.

[2] The Air Force's historical emphasis on satisfying "national" customers at the expense of tactical warfighting support deserves much of the blame for this condition. In the Air Force's defense, however, those "national" systems were developed and deployed primarily to aid in avoiding nuclear war, a mission they served well. Additionally, because of security classification restrictions, much of the useful data collected by these early systems was not releasable to the warfighters. Many of the underlying causes for this mistrust either have been fixed or they are in the process of being changed. The Air

Notes

Force is well aware of the force enhancement value of space systems and is working hard to correct many of its past philosophical ills; relaxation of security restrictions has been directed from the national level and formerly unreleasable information is now available to the operational and tactical warfighters in daily increasing quantity. The author witnessed a National Reconnaissance Organization (NRO) briefing on 28 March 1997 that included information at the SECRET level that only a few months ago was not allowed to be shared among different offices within the NRO itself. In short, it is time to put aside past experiences, stop the interservice quibbling and get on with the business of developing future space forces to meet 21st century security challenges.

[3] All three services have a command structure established to handle their space issues, the Air Force Space Command is by far the largest of the three. NASA handles US civil space; manned and reusable launch vehicle requirements do not mesh well, making congressionally-directed NASA and DOD cooperation on launch programs difficult. The military established a Space Architect to oversee cooperation in military space efforts, but OSD then created a Deputy Under Secretary of Defense for Space (DUSD Space) and absorbed the new Service executive. With increased influence in OSD/C^3I and on the Joint Staff, it is impossible to reach consensus on critical space issues. Sometime, the common complaint goes, it is hard to tell who, if anyone, is in charge of space.

[4] An obvious reference to World War Two doctrine developed at the Air Corps Tactical School (ACTS) at Maxwell AFB that led to severe bomber losses, particularly by Eighth Air Force in campaigns over Germany. The doctrine assumed there was no defense against such raids, but failed to account for improved technology in air defenses. Space advocates should take caution when we talk about offensive space weapons and their apparent invincibility.

[5] Personal conversations with “shipmates” while assigned to Naval Space Command, Dahlgren, Va., 1985-1989.

[6] “Aerospace Doctrine--More Than Just a Theory,” Air War College handout reprinted from Policy Letter Digest, June 1996.

[7] “Aerospace Doctrine...”, comments edited in order of appearance in cited article.

[8] William P. Snyder, “Strategy: Defining It, Understanding It, and Making It”, reprinted with permission in Air War College SDA Reader: Volume I, AY 97, 1.

[9] Air War College seminar lectures, Sep-Oct 1996.

[10] General Ronald Fogleman, Air Force Doctrine Document 4, Space Operations Doctrine, (Draft), 10 July 96, 5.

[11] Major Steven R. Petersen, *Space Control and the Role of Antisatellite Weapons*, Research Report no. AU-ARI-90-7 (Maxwell AFB, AL: Air University Press, May 1991), 14.

[12] Major Robert D. Newberry, “Space Doctrine for the 21st Century,” Research Report no. AU/ACSC/0427/97-03 (Maxwell AFB AL: Air Command and Staff College, 1997), 1.

[13] Newberry, 54-60.

Notes

[14] Although this statement begs argument of the "fourth service" issue, I will not attempt to address it here. See discussion in Chapter 2.

[15] There is widespread disagreement on exactly where space begins. *Air Force Magazine* listed in its August 1996 "Almanac" the following descriptions: stratosphere begins at 10 miles above the surface, limit for turbojet engines at 20 miles, limit for ramjet engines at 28 miles, astronaut wings awarded at 50 miles, and low earth orbit begins at 60 miles. Although it is possible to orbit at 60 miles (theoretically at any altitude, given sufficient velocity), no existing system operates at that altitude due to energy requirements and short orbit life span.

[16] Petersen, 19.

[17] Ibid, 2. Major Petersen discusses the importance of space "geometry." Basing on the moon, asteroids, or in stable orbits around the LaGrange libration points, especially L-4 and L-5, are feasible and, in many cases, desirable if one takes the "high ground" argument to the extreme and ignores current prohibitions against using the lunar surface for military purposes. An interesting discussion on "gravity wells" and their military advantage is found in G. Harry Stine's book, *Confrontation in Space.* He has written eight other books which, though slightly dated, are worth review.

[18] Owen E. "Juice" Jensen, personal correspondence, 15 March 1997. Although overflight issues restrict certain air-breathing platform operations today, it is by and large a US decision. In fact, due to US military strength, the US can fly anywhere it chooses. Exercising that capability is not, however, politically feasible and would only be ordered by National Command Authority (NCA) in cases of extreme national emergency. Currently, all space faring nations enjoy unrestricted overflight by their satellites and manned platforms. This condition is primarily technology driven. Most nations would probably restrict overflight of their vertically extended sovereign borders if they could enforce such a policy. Since the capability does not exist, nations choose to ignore space overflight. This will not always be the case. We can not forget that there was a time when we thought Russia could not reach our U2 aircraft. The US must begin to think through alternatives now in order to prepare for the day when US space systems are at risk. This and several other proposed tenets of space doctrine listed here are derived from many conversations with Juice over the past eight years.

[19] Major General Robert Dickman, OSD Space Architect, interviewed by author during visit to Maxwell AFB, 26 February 1997.

[20] Jensen. According to Juice, if we could travel vertically 120 miles at the same cost of traveling horizontally 12,000 miles, we'd all be taking vacations in space and the US would launch battleships. The single most limiting factor in US reluctance to fully exploit the space medium is launch costs.

Chapter 2

Leadership

I have flown in just about everything, with all kinds of pilots in all parts of the world—British, French, Pakistani, Iranian, Japanese, Chinese—and there wasn't a dime's worth of difference between any of them except for one unchanging, certain fact: the best, most skillful pilot had the most experience.

—Charles E. "Chuck" Yeager

Introduction

The Air Force spends a significant portion of its budget training and educating people to achieve technical competence in major functional areas. This is only one of the many ways the Air Force has attained, and continues to maintain, its position as the world's most respected air and space force. The Air Force chooses its leaders from a very large corps of extremely competent airmen grown through years of experience, training and education in their respective professional specialty.

The best and brightest of those pilots, lawyers, doctors, and professionals from acquisition, communications, intelligence, logistics and other fields are chosen for the leadership positions of each major functional area, and for good reason. Those leaders must possess a high degree of technical competence in their field. In general, naval officers run the Navy, combat soldiers run the Army and the top airmen run the Air Force.

Within certain functional subgroups, those chosen for leadership positions reflect still further allegiance to the principle of functional expertise: ship drivers run the surface Navy, submariners run the submarine force, infantry and armor experts lead their respective forces, and pilots lead the "flying Air Force", Air Combat Command (ACC) and Air Mobility Command (AMC).

As the Air Force begins its transition from an air and space force to a *space and air force*, two questions arise concerning senior leadership in the space mission area:

- Who leads the current space forces?
- Who will lead the future space forces?

Analysis of the career demographics of current "space leadership" indicates the Air Force has departed from the leadership development model used throughout the flying forces. That model trained airmen to operate their weapon system, honed their proficiency to unsurpassed skill levels, prepared them to manage their force structure, then selected the best of them for senior leadership positions. The same has not been true for space forces.

This chapter examines the experience background of current Air Force Space Command key leadership positions and finds there is a large discrepancy in functional area expertise between those leaders and others in similar positions within the Air Force. It explores several reasons for the current low levels of space experience at Air Force Space Command, discusses some possible implications, then outlines some options, from a space operator's perspective, that might put the Air Force on the right track.

Background

Air Force Space Command (AFSPC), established 1 September 1982, is the newest member of the "Combat Air Forces" (CAF) or warfighting arm of the USAF. This is a result of the intercontinental ballistic missile (ICBM) force being transferred from ACC in the early 1990s to AFSPC. Headquartered in Colorado Springs, Colorado, the command contains two Numbered Air Forces (NAF), Fourteenth Air Force (14AF) at Vandenberg AFB, California and Twentieth Air Force (20AF) at F. E. Warren AFB, Wyoming. The 14AF's four wings perform the "space operations" portion of AFSPC's mission and it provides forces as the Air Force component to the United States Space Command (USSPACECOM), while the 20AF operates ICBM forces in support of United States Strategic Command (USSTRATCOM).

The command operates six bases, seven stations and more than fifty units worldwide.[1] Over 38,000 active duty, reserve, civilian and contractor personnel operate, maintain, and support AFSPC's space and missile force structure.

Analysis Methodology

Since the focus here is on "space leadership," this paper analyzes only the flag officer experience demographics of the space portion of AFSPC's mission area, headquarters AFSPC and its four space wings which operate launch, space surveillance and warning, and satellite command and control forces.

All data in this study was extracted from flag officer biographies provided by major command (MAJCOM) public affairs offices or MAJCOM home pages on the World Wide Web. Data is current as of 31 December 1996, the cutoff date for this analysis.

"Leadership position" as used in this paper is defined as a flag officer billet at the commander, vice commander or "two letter" level (e.g., DO, XP, DR). Because the paper assumes an "operational" slant to its analysis, positions such as engineering, legal and medical are excluded.[2] No senior enlisted data was used; however, this presents an excellent area for future analysis.

Defining data fields is often a totally subjective exercise, as it was in many cases in this study, therefore an explanation of several terms used arbitrarily in this analysis is in order:

- *Years fly/space/missile*: includes assignments in an operational unit, command or staff position, Air Staff, major command or numbered air force headquarters, etc., directly related to the specified mission area.
- *Years other*: includes Professional Military Education (PME) in residence, graduate school, assignments in other functional areas such as personnel, Air Force Academy instructor duty, photo interpreter, etc.
- *Unit operations (ops)*: credits assignments as a line crew member including training and standardization/evaluation, operations officer or squadron commander.

For comparative purposes, similar analysis of senior leadership in Air Mobility Command (AMC) is included. This offers a "flying" force contrast and, since its primary function is not direct fire but combat support, serves as an appropriate benchmark for AFSPC's similar role.

Flag Officer Experience Summary

Figure 2 represents a comparison between AMC and AFSPC flag officers' total active duty and percentage of career time spent in their respective "functional areas"—flying versus space and missile assignments. Although AFSPC flag officers are slightly more experienced airmen, 28.3 years of active duty service to 27.8 years, they have spent

a significantly lower percentage of their careers in their functional area, 39% compared to 90% in AMC.

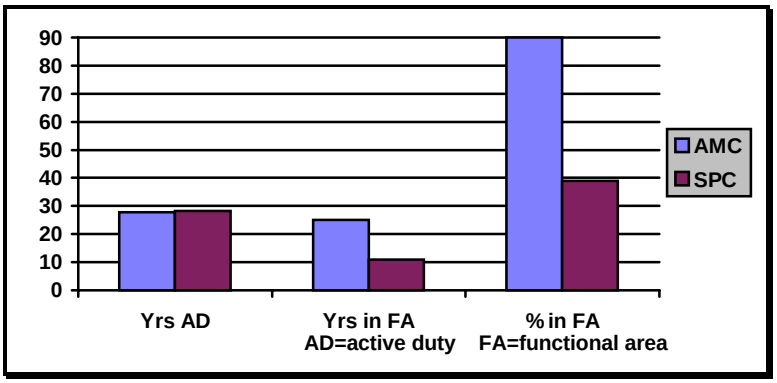

Figure 2. "Experience" in AMC and AFSPC

Figure 3 represents the same comparison, but with "missile experience" excluded from the AFSPC data, giving a space-experience-to-flying-experience ratio that traditionalists might find alarming. From a purely "space" perspective, AFSPC leaders have spent only 14% of their careers in the space business with the majority of that time being spent at the staff level. By comparison, AMC leadership has accumulated a 90% "in functional area" rate.

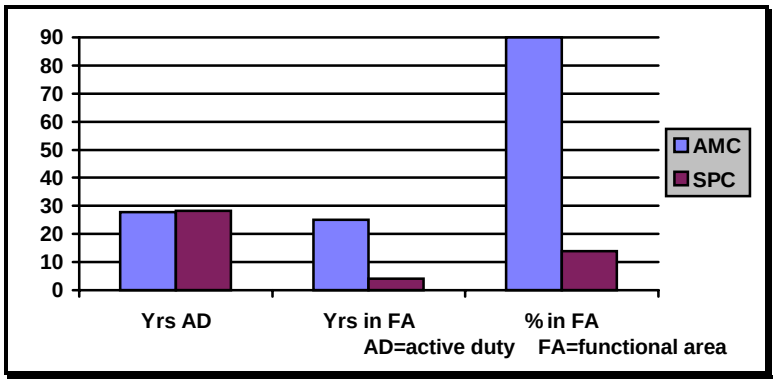

Figure 3. Total "Space" Experience

Further breakdown of flag officer assignments into functional mission areas of flying, space, missile and "other" reveals AMC flag officers have been trained and

educated totally within their rated structure. On the other hand, AFSPC flag officers display a much broader experience base with assignments across the spectrum, as represented in Figure 4. Of particular note is that of the four areas listed, *space mission area experience ranks last.* AFSPC flag officers have more experience in each of the flying, missile and "other" areas than they do in space related assignments.

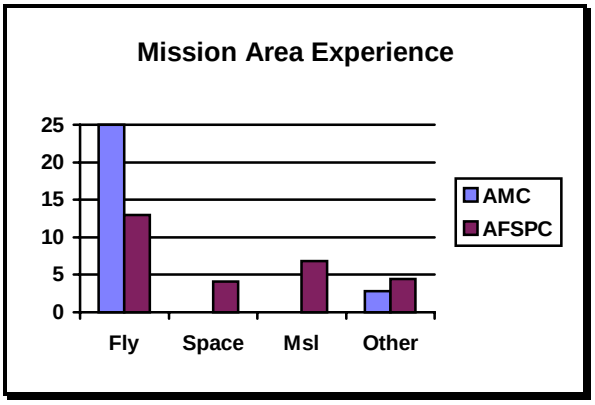

Figure 4. Years of Experience by Mission Area

While some might consider this broad, across-the-Air Force experience base a positive condition for its leadership team, others would prefer that its leaderships' broadening take place within its own functional area, for example by "flying" different weapon systems, but flying all the while. It is obvious from the low number of years spent in space assignments, an average of 4.1 years, AFSPC leadership has not had the opportunity to broaden within the space business. None, in fact, have "stick" time[3] in the basic space operations systems—launch, surveillance/warning, and satellite command and control.

Figure 5 depicts the percentage of flag officers analyzed who have unit level operational experience. Clearly, operational experience at the unit level is important to

AMC and 100% of the officers studied have actually flown some, if not all, of the weapon systems early in their careers that are now under their control.

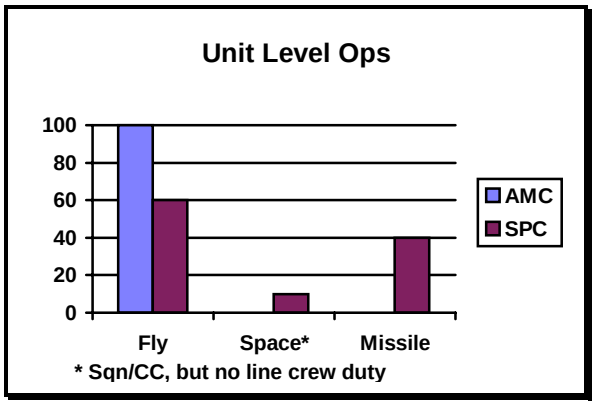

Figure 5. Percentage With Unit Ops Experience

By contrast, none of the 14AF wing commanders have unit level operations experience in any of the systems under their command. Furthermore, from an organize, train and equip perspective, only one of the six flag officers at AFSPC headquarters charged with managing space resources has unit level ops experience.[4] How did the Air Force get to this point and what does it mean?

Factors Influencing the Space Experience Void

The Soviet Union launched the first satellite 40 years ago this October. The United States was only a few months behind with its first successful launch, and wasted little time in an attempt to exploit the obvious military advantages offered by the new "high ground." Consequently, the US has operated military space systems for nearly 40 years, so one has to wonder why there is so little space experience at senior levels in Air Force Space Command.

The answer is primarily one of relative priorities. The AF has been deeply involved in a Cold War for practically all of the military space era and avoiding nuclear war was

clearly the nation's first priority. Investment in deterrence tools, long range bombers, intercontinental ballistic missiles, and air superiority fighters along with all the supporting infrastructure and personnel ate constantly at predominantly austere budgets. There were simply not enough dollars to support robust space programs while preparing for and trying to prevent nuclear war. Likewise, AF officers who were reared in the service's war machinery were, appropriately, assigned the task of leading the AF's business to "fly and fight." Thus began a cycle of no significant forces-no significant leader population.

Treaties, technology, policy doctrine and intraservice competition for resources prevented the US from aggressively pursuing a war fighting capability in space. Major space systems were assigned the responsibility to surveil, alert, warn and communicate; no more, no less. National command authorities soon became the principal user base for space systems and little emphasis was placed on direct contributions to operational and tactical combat operations. Space systems acquired a "national level strategic" reputation and Air Force leadership saw little benefit to spending scarce dollars on finding ways to exploit the space medium as a means of improving the Air Force's warfighting capability. No space-trained senior leadership existed to advocate for investment in this area and the no forces-no leaders cycle became even stronger.

Due to the highly technical nature and extreme risk[5] associated with space operations, functional management of AF space business was delegated to the research, development and acquisition community. The AF created its first operational command for space less than 15 years ago, so one could argue that there has not been sufficient time to "grow" a corps of operationally experienced space leaders. That, however, is not a valid argument when one is reminded that regardless of the organizational structure

within the AF, someone operated the systems under Strategic Air Command (SAC) and Air Force Systems Command[6] guidance. So where have all those space operators gone, and why did the AF fail to cultivate the requisite leadership base from which to choose its space leaders?

Much of the blame rests within the space community. Since space systems have always been extremely expensive to acquire and operate, experience in program and financial management has historically been viewed as more important to success in the space career field than operational experience. Today there is only one four star general in the AF with a space background, and that background is primarily in space system acquisition.

It is worth mentioning here that the space community has not been idle in its attempts to grow its share of flag officers yet events far beyond its control have contributed to today's condition.[7] For instance, just a few years ago one of space's "stars" sadly suffered a career ending illness. Although denied his destiny to become an Air Force senior leader, he continues to make valuable contributions to the space industry from his position in the commercial sector while continuing his battle with cancer. Still another brilliant officer, recently denied a second star, announced his retirement scheduled for later this summer—apparently the victim of too much time in one specialized area, the National Reconnaissance Office (NRO). A former colleague in the same business retired recently for the same apparent reason, depriving the Air Force of another meaningful voice at the table in the debate over force structure. Finally, the space community lost one of its brightest future leaders last year when he was not promoted to flag rank because he did not meet the career criteria apparently applied to flag candidates, the most obvious

being no early promotions. This loss was devastating to many military members who had the privilege to serve with him and came as a bitter disappointment in the general officer selection process. The Air Force lost one of its most energetic and visionary warfighters and a badly needed space-experienced senior leader.

The AF shoulders much of the blame for the current state of affairs with its space leadership. In addition to its failure to recognize leadership potential in the three cases above, one could argue the AF was terribly short-sighted in failing to fully exploit the military potential of space technology with the same fervor it did 80 years ago with the revolutionary new airplane. Early air power advocates envisioned flying and fighting above the atmosphere and AF Chief of Staff General Thomas White argued for robust investment and development in war-fighting capability from space as early as the 1950s, so the concept has existed longer than our ability to access and exploit space. However, space advocates could not muster the support necessary to successfully compete for the resources needed to fully exploit the military potential of space. The no forces-no leaders cycle continued and without a true war-fighting mission, space leadership development simply was not important to the institution. Without a sufficient number of senior leaders at the operational MAJCOM and AF headquarters level to advocate for new space capabilities, there has been no serious competition for scarce resources between air and space forces. So, what does all this mean?

Implications

Militarily, the most severe damage has been a failure to adequately conduct the debate over Air Force doctrine and what balanced force structure the Air Force could best

use to project force upon its assigned targets. As a result, modernization of space forces to include both modifications and new acquisitions has lagged far behind the pace set by airplane enthusiasts the first forty years of that technology's existence. The Air Force is thirty years behind schedule and it has not pushed the space capabilities envelope very far since 1957.

Most space systems in operation today are ground based, old, low-tech, slow, manpower intensive, and years behind the state of the art in associated technologies. As a result, they are difficult to train, inefficient to operate and expensive to maintain. Operation of space systems has been so low on the AF priority list for so long, it is only within the past four years that the AF has sought institutional help in providing adequate training for space operators.

Recent initiatives with the Air Education and Training Command (AETC) promise to provided much needed help with legacy systems while future space systems acquisition will include a complete training package of simulation capability, instructional material and documentation to support operations and training. It has been the rule rather than the exception for the past 20 years that new space operators were trained on operational equipment with documentation derived by word of mouth and experience far more than from credible system documentation. Support tools for space systems were traditionally traded off for cost and schedule as program budgets neared their ceiling. Why? Leader-ship structure played a large role.

Traditionally, as previously noted, space operators did not rise through the prevailing leadership development structure. Due to the makeup of AF force structure, there was never a need for more than one or two space-experienced generals and those few billets

were reserved for those with space "business" experience rather than space operations experience. As a result, the operator's voice has seldom, if ever, been present at critical decision making sessions conducted at the senior leadership level. Today, that same condition exists not only throughout AFSPC, but the AF as well. While weapon system *effectiveness*, or how well the system performs, is important to an operator, program managers are graded on program *efficiency*, or how well the program executes from a cost and schedule perspective. This divergent philosophical difference has exacted a severe price from the Air Force's military space capability.

The AF Chief of Staff has recently endorsed language suggesting the AF is in transition "from an air and space force . . . to a *space and air force*." Clearly, he sees the future of the AF closely tied to its ability to develop a viable military capability in space. The good news is that the AF now talks regularly of "air and space power" in place of the old "air power" only jargon. The bad news is that it is still only talk.

A recent reorganization of the operations staff at Headquarters Air Force produced the word "space" in its title. Conspicuous by its absence, however, is a two-star led organization within the air and space operations staff charged with leadership and oversight of space strategy, applications, operational concepts and force development. Absent from all other organizations is a "space one-star" deputy and a cadre of "space colonels" fully imbedded throughout the four-and-five-letter offices on the staff.

Finally, the most critical blow to the development of space forces is the reluctance to migrate dollars from current defense spending into the space investment program. Carl Builder disagrees with this paper's "no forces-no leaders cycle" thesis which contends that if senior leaders are present at the table, rational debate will lead to proper

resourcing. He argues the opposite, that "power will follow the money. Once the resources are redirected, people and careers will fall all over themselves to be where the action is."[8] He does not believe the Air Force will willingly reallocate resources into space programs and cites historical examples of higher authority intervening in the process. President Roosevelt made the Army's decision in the debate over the creation of a separate Air Force and Secretary of Defense McNamara helped the Navy in their debate over carriers and ballistic missile submarines. Mr. Builder believes similar presidential or congressional intervention is required to reshape the nation's investment priorities. Sadly, he may be correct.

Given an apparent reluctance by the Air Force to fully implement the transition, one has to wonder if the AF will progress sufficiently over the next 25 years to meet the challenges that lie ahead. It will require more than bumper stickers. It will require money, manpower, commitment and action.

What to Do

The solution is really very simple and the Air Force already has the answer. All it has to do is follow the leadership development model used for 50 years to grow its flying leaders, a task the Air Force has performed well. Simply train, educate and prepare airmen selected primarily from core space operational units for senior space leadership positions.

One critical step is to stop using command of space operational units as a reward for superior performers from other career areas. Every time a communicator, acquisition professional, weather expert, helicopter pilot or anyone else takes a command position at

a space unit, another space operator misses the opportunity to progress and gain valuable leadership experience in his or her core mission area. Circumstances exist for exceptions, of course, but these should be exceptions rather than the rule as it has been for over 20 years in the space business. The historical lack of adequate space operator leadership in key flag officer and colonel positions has only served to keep this practice alive, a self serving loop succeeding only in perpetuating this devastating practice, much like the no forces-no leader cycle described earlier.

Next, put space experience in key positions throughout AFSPC. Where "flying expertise" or "warfighter advice" is needed for proper influence, import it, but put those experts in principal deputy or key "advisory" positions similar to legal and medical assistance provided to commanders. Let them advise, but keep the critical decision making authority within the space career field. Senior leadership will know if the right decisions are being made in the best interests of the AF. If they are not, replace the decision maker, but replace him or her with a properly trained, educated and prepared space expert, not someone from another field.

Further, the Air Force must add space experience to the Air Staff in large numbers and in great haste. Create XOS now, put the right space two-star and a full staff in there and charge them with leading the AF's space efforts. Add space experts to all director-ates and install as many one-star and colonel deputies as there are from other functional areas. The same process must take place in the Secretariat, Office of the Secretary of Defense (OSD) and the Joint Staff.

Finally, properly prepare future space leaders through training and education programs. The Air Force should create rated supplement-like programs for young space

operators so they can begin to grow through 12-18 month apprenticeship assignments every five years to additional operational systems, acquisition, logistics, communications, intelligence and other critical fields. Develop robust programs at Air University for all levels of professional military education for officers and senior enlisted alike. Ensure graduate and post graduate level education in space related subject areas is readily available and encouraged, not only for captains and majors, but lieutenant colonels and colonels as well. The model has been around for years; and it is time to apply it to future space leaders now.

Summary

The Air Force can no longer manage its space mission area the same way it has the past 40 years. In the 14 years since standing up an operational command for space forces, no space-trained four star has commanded AFSPC. When the AF stood up a numbered air force to take on the war fighting responsibilities of its operational space forces, it could not find a general officer with a space background to command the organization. Three consecutive commanders have come from backgrounds other than space, and the recently announced fourth commander has less than three years of space experience, none at the operational unit level.

Near term statistics may improve slightly with the recent selection of a "space operator" to command a missile wing, presumably en route to flag rank. Additionally, a three-star space operator is currently honing his acquisition skills in Los Angeles and may return to AFSPC or to AF headquarters, both in dire need of more space experience. Finally, a two-star career space officer is scheduled to leave an OSD position this

summer, hopefully with a nomination for a third star and back into a space leadership role. But the Air Force continues to fill vacancies requiring space experience with space-inexperienced flag officers.

A former space NAF commander, with less than five years space experience, was recently awarded a third star and is headed to Washington to add the best three star "space voice" available to that debate table. The recent announcement of a new one-star-select with no space experience as the next launch wing commander provided a grim reminder that in the 14 year existence of the Air Force's operational Space Command, it has been unable to prepare enough of its majors, lieutenant colonels or colonels adequately to perform at the general officer level. Due to this understandable, yet unforgivable failure, there are simply not enough Air Force generals today with space experience. Launching the Air Force into its transition to a predominantly space force will prove difficult without adequate leadership experienced in the fundamentals of space programs and operations.

Flag officer leadership at Air Force Space Command has a comparatively low level of experience in space systems and that trend appears to be in place for the foreseeable future. AFSPC general officers average slightly more than four years in space related assignments over an average 28 year career. Senior leaders without space experience is not a new condition and its existence for nearly 40 years is largely responsible for the lack of development of modern, robust military space systems. Likewise, the lack of space experience throughout the space community, as well as the Air Force in general, has prevented the creation of an adequate leadership development mechanism for future space leaders. As the Air Force begins to transition from an air and space force to a space and air force, this is an undesirable condition. Steps must be taken now to implement the

same development model the Air Force has used for years to grow its future leaders of the flying Air Force. Without it, the Air Force will not be prepared to meet the challenges of 2025 and beyond.

Notes

[1] USAF Almanac 1996. *Air Force Magazine*, May 1996, 86.

[2] It is interesting to note, however, and consistent with results of flying operations analysis, that leaders at the MAJCOM level in civil engineering, medicine, and law were all career engineers, doctors, or lawyers, respectively. This provides perhaps even stronger evidence of the principle of functional expertise in areas considered to be of vital importance and thus immune from functional crossovers.

[3] All AFSPC commanders at the squadron, group and wing level are qualified "mission ready" in a weapon system. This is not equivalent to the experience gained from years of line crew duty.

[4] "Unit ops" credit given for a squadron commander assignment. However, no operational experience below this level (line crew duty) would support the argument that no headquarters level general officers have unit level experience in a space operations system.

[5] Not to be interpreted as risk to life, but rather a technological risk. Early space launches, for instance, provided a spectacular legacy of fiery failures.

[6] SAC no longer exists and Systems Command was the forerunner to AF Material Command.

[7] Lt Gen Roger DeKok, Commander Headquarters Space and Missile Systems Center, personal correspondence 19 March 1997.

[8] Carl Builder, RAND Corporation, personal correspondence 24 February 1997.

Chapter 3

Technology Challenges

Our prowess in technology has been and will continue to be one of our country's greatest assets, and its application to military capabilities is of critical importance to our national security. We pursue these military applications partly because we do it very well, but even more because, as Professor Hans Morgenthau wrote in Politics Among Nations: "The fate of nations and of civilization has often been determined by a differential in the technology of warfare for which the inferior side was unable to compensate in other ways." Technology can make a difference.

—Defense Secretary Harold Brown,
on leaving office, January 19, 1981

Introduction

Space is the fourth dimension of war[1] and the United States is not prepared to conduct war in and from space. As previously argued in this paper, the Air Force has no doctrine, strategy or force structure to support warfighting operations in this new dimension. In spite of claims that the US recently fought the "first space war" in the Gulf, the reality is that no fired a single bullet from space. Space support systems—weather, navigation, warning, surveillance, communications platforms—certainly aided traditional land, air and sea forces in their conduct of the war, but the US did not, by any stretch of the imagination, fight a space war.

The time has arrived, however, to prepare for such an event. *Should we? Can we? Will we?* The first and third questions imply an examination of the threat, national security objectives, national policy, legal, moral, political, and national-will issues this paper avoids by simply stating yes, we must and we will. This chapter focuses on the "can we?" question by looking at basic operational requirements for a warfighting capability in space and several key supporting technologies. First, and foremost, the US must have *access to space* in order to deploy its forces; additionally, *weapons* designed to engage targets in space and on earth must be developed; the ability *to locate and target* with unprecedented precision is paramount; *command and control* (C^2) of forces operating at near the speed of light, often autonomously, will require new skills and new systems to gather, process and distribute information; and, finally, weapons effectiveness in the form of *battle damage assessment* of targeted platforms will be critical to the proper employment of space based weapons.

Access to Space

> *The driving cost element is launch. If the cost of going 120 miles vertically were as low as going 12,000 miles horizontally, we'd all take our vacations in space. If launch costs were zero, we could (and would) orbit battleships.*
>
> —Owen E. "Juice" Jensen

The need to assure reusable, low-cost, high sortie rate, airplane-like launch operations is the single most pressing technological challenge to US space superiority. Given technological breakthroughs that would allow rapid development of feasible weapons, the US in all likelihood could not afford to deploy and sustain those weapons in space due to the current excessive costs of getting them on station. Launch costs of $100

a pound[2], or even lower, are necessary to fully exploit space as a warfighting medium. Once promised-but-never-achieved launch costs of around $100 a pound for the space shuttle soon leveled out at nearer $10,000, and other heavy lift vehicles are currently in the same range. Technology advancements in selected areas could make that level achievable.

The Quest for "the Holy Grail,"[3] Enhanced I_{sp}

Two pieces of the launch cost puzzle must be solved: thrust and weight. To achieve more thrust engineers must develop more efficient fuels and better engines to produce higher specific impulse (I_{sp}), the commonly accepted efficiency rating for rocket engines. In general, the higher the I_{sp},[4] the more efficient the engine and, intuitively, the more weight a particular rocket can carry to orbit. For example, for each second of increase in Iequates to roughly 100 pounds of additional payload for the Atlas and Delta rockets.[5]

In the rocket thrust equation, "there are many variables in rocket design that affect payload fraction, or mission capability, but the most significant factor is the energy density of the rocket propellant used."[6] More payload to orbit resulting from higher I_{sp} is the goal of many research and development efforts across the country,[7] all attempting to find new fuels with maximum energy in the smallest mass possible. Propellant energy density, according to Phillips Laboratory, is the most significant factor in determining the capability of missiles and launch vehicles.

The most promising area of current research is in metallic derivatives of conventional fuels. Current liquid propellant combinations yield I_{sp} in the 250-400 second range, while solid propellants produce 200-300 I_{sp}.[8] By contrast, according to an April 1990 report from Technische University in Berlin, metallic hydrogen yields a theoretical I_{sp} of 1700

seconds. Provided there is an atomic metallic state of hydrogen, which is yet to be proven, metallic hydrogen could satisfy the demands of advanced launch vehicle propulsion in the 21st century.

Materials: The Key to Lighter Weight

Although the major factor, higher thrust is not the single solution for a "high I_{SP} rocket motor does little good if the weight of the vehicle is not controlled."[9] New lightweight materials that can withstand the tremendous forces experienced during launch and ascent are needed for boosters and payloads. Additionally, booster and satellite vehicle structure improvements, such as composite cryogenic tanks, polycynate-ester resin systems (PERS), and piezoelectric sensors and actuators, can further reduce total launch weight.[10]

Weight reductions in payloads will improve thrust to weight ratios and help lower costs. Obvious downsizing of traditionally large payloads to smaller, single function systems is one popular approach, but it may not be the right answer. Instead, a more satisfactory and far reaching solution lies in lighter materials, new power sources for space systems and miniaturization of components[11] to achieve smaller, lighter payloads. Significant progress in these technologies is critical to the success of nearly every facet of space operations. With the advent of autonomous spacecraft operations, reduced ground support, and the integration of complex systems for assured control of space weapons, it appears that satellites will "grow"—the Air Force must ensure they grow smaller through the application of new technologies, not by removing capability.

Space-Based Weapons

> *Wilbur Wright has made the statement that in his opinion the use of the aeroplane for dropping bombs or explosives into a hostile army is impracticable, as the machines must rise 1,000 or 1,500 feet above the ground to escape shell fire. At that height accuracy would be impossible in dropping explosives when moving at 40 to 50 miles an hour. He believes their only use in war will be as scouts and messengers.*
>
> —Popular Mechanics, July 1909[12].

Space based weapons have the potential to become the most versatile, lethal, effective and efficient force projection alternative in the US arsenal. For these reasons, technologies supporting development of space based weapons should become a national research and development (R&D) priority. Efforts undertaken in development of Strategic Defense Initiative (SDI) concepts should be leveraged and expanded to create a Strategic Offense Initiative.

General Characteristics

Space-based weapons should be developed to be lethal or non-lethal; kinetic or directed energy; data capture, disruptive, or manipulative; designed to occupy orbits in low, mid, high, or extra-earth- realms;[13] and they should be manned or autonomous platforms. Weapons in space should be able to engage space based, air, land and sea targets instantly, with no warning, and with extreme precision. They should be capable of operating independently or in concert with terrestrial forces in simultaneous, parallel attack.

Maneuverability and Power

An offensive capability in space depends on research breakthroughs similar to those needed for a capable lift force—materials, energy, and miniaturization. Space platforms

of the future must not be limited to “in plane” maneuvers, they must be capable of “airplane” maneuvers. New methods of generating high levels of thrust to obtain new orbits and return, quickly and often, are necessary. Power sources, such as atomic or solar, are needed to sustain long life on orbit and generate the energy necessary to propel streams of light, electrons, neutrons or other forms of particles in both lethal and non-lethal doses to targets over great distances. Short wavelength weapons using gamma and X rays promise to be smaller, lighter, and more efficient.

Defensive Capability and the Environment

Weapon systems in space may have to act as their own suppression of enemy defenses and escort, so self defense suites that detect and counter an attack against them must be developed and either be built into the platform or deployed as a separate force. The operating environment for space forces is extremely hostile and still holds many mysteries. The Air Force must begin to collect data from every vehicle launched into orbit, model and study the data and develop a complete understanding of the risks and opportunities associated with operating in the space environment. US forces in space must be “smarter” than any potential adversary. Discoveries similar to the Navy’s exploitation of thermal layers in water and their effect on sonar, and the resultant impact on submarine warfare, are waiting in space. Failure to master the space environment will place US forces at a distinct, and possibly fatal, disadvantage to those who do.

Targeting

Weapons in space will be of little utility unless they are able to detect, track, identify, discriminate, target, close and engage with both accuracy and precision. Finding the right

target, selecting the right aim point, and engaging at the proper moment require vast improvements in surveillance, reconnaissance intelligence, data storage and processing capabilities. Engaging entire platforms will be difficult enough at the relative speeds encountered between shooter and target in space. Knowing exactly who and how to disrupt, deny, delay or destroy individual sensors, discrete data channels or even specific bit streams selected for attack will require the most precise intelligence data bases imaginable.

Being “instantly aware” as called for in the Air Force 2025 study will require wide area earth surveillance of vehicles, aircraft, ships, troops, missiles, terrain and weather. In the space environment there will be a significantly greater space population (e.g., Iridium) and targeteers must know what is in orbit, and exactly where it is, at all times to a greater degree of accuracy than currently available. For instance, the existing ground based space surveillance system tracks orbiting vehicles at an acceptable accuracy level measured in kilometers. Accuracy in the centimeter range must be achieved in order to discriminate between platforms and engage targets down to the component level. Precision laser tracking and imaging technologies offer the most promising solution to this problem, but short term improvements to the currently existing US tracking systems are required to lay the groundwork for future weapons system development and testing.

Command and Control

> *In the future, our biggest limiting factor could be the lack of skilled personnel in the space career field.*
>
> —MGen Robert A. Rosenberg

Command and control of space based weapons, many of which may operate in an autonomous or semi-autonomous mode, will require both new systems and new skills. No one has ever operated forces in battle that move at kilometers per second and can respond at the speed of light. Targeting and decision aids utilizing artificial intelligence capabilities will be the norm in space warfare. Massive amounts of information must be processed and collated in a coordinated attack with ground forces. Command centers must be able to display not only global awareness pictures, but the entire space environment as well, and in real time. Decision makers must be able to train and exercise in realistic virtual battlespaces with the aid of holographic displays, voice actuated command tools, and instantly available data bases. New methods of weapon release authority and validation must be developed to include "fail safe" mechanisms built with the 2025 information warfare threat in mind.

Battle Damage Assessment

Coupled with the "instantly aware" capabilities mentioned earlier will be the need to assess the effectiveness of space based weapons. First, complete knowledge of the target, its components, capabilities, and operations profile will be necessary to distinguish between a "kill" and simple maintenance activities or deliberate deception. Space-based weapons will need to look and listen after each "shot" to ascertain target status, then fold that information into a real time revisit decision cycle. In space warfare, a 48-hour Air

Tasking Order (ATO) may shrink to a 3-minute, or even 3-second ATO. Instant collection, rapid processing and short decision cycles will require all the capabilities previously cited and the enabling technologies in materials, energy, power, and miniaturization.

Summary

> *Popular interest in Dr. Goddard's rocket for reaching high altitudes was excited by the claim that this projectile could actually be made to travel to the moon . . . there is something romantic in the thought [but] it would serve merely as a demonstration of the power of man to overcome seemingly insurmountable handicaps.*
>
> —Scientific American, April 1920[14]

Mankind has yet to encounter a medium he could travel and occupy without developing the ability to wage war there. Space promises to be no different and the United States must undertake a rigorous effort to ensure we are not second in yet another race to military superiority.

Enabling technologies in higher I_{sp} fuels and engines, stronger lightweight materials, miniaturized components, new energy and power sources, and collection, processing, distribution, and display techniques are paramount to this effort. Someone will eventually put weapons in space and it is the duty of Air Force professionals to think about, debate, plan for and develop that capability for US forces. To fail in this task will risk certain defeat in a future war.

Notes

[1] Gen Ronald Fogleman, CSAF, AFDD 4 (Draft), 10 July 96, p5.

[2] Air Force Space Command, "Air Force Long Range Plan: Space Team View", Briefing Presented to AWC Space Issues Elective, AY96.

Notes

[3] John M. Collins, *Military Space Forces—The Next Fifty Years*, Pergamon-Brassey's International Defense Publishers, Inc., Washington, 1989, 103.

[4] ISP is the ratio, measured in seconds, of thrust to pounds of fuel burned in one second. For example, an engine that produces 1000 pounds of thrust while burning 50 pounds of fuel in 10 seconds would have an ISP of 200 (1000 pounds divided by 50 pounds/10 seconds.)

[5] "High Energy Density Materials (HEDM) Breakthrough in Rocket Fuel," Phillips Laboratory Fact Sheet, undated, n.p.; on-line, Internet, 22 March 1997, available from http://www. plk.af.mil/SUCCESS/hedm.html.

[6] "High Energy Density Materials," Philips Laboratory Fact Sheet, undated, n.p.; on-line, Internet, 22 March 1997, available from http://www.plk.af.mil/OR...FACTSHEET-/hidenmat.html.

[7] Air Force, NASA and other labs are working cooperatively with over 20 university and research centers to advance rocket propulsion capabilities through concerted government-and-industry-based advances in Integrated High Pay-off Rocket Propulsion Technology (IHPRPT) efforts.

[8] Major Michael Muolo, *Space Handbook: An Analysts Guide*, AU-18, (Maxwell AFB AL: Air University Press, December 1993), 103, 115.

[9] William E. Clapp, EdD., "Space Fundamentals For The Warfighter," US Naval War College Research Report 3-94, May 1994.

[10] Air Force Scientific Advisory Board, *New World Vistas: Air and Space Power for the 21st Century*, Space Technology Volume, 15 December 1995, 19-25.

[11] For an intriguing look at an exciting, albeit controversial, quantum leap in miniaturization technology, see "Waiting For Breakthroughs", Gary Stix, staff writer, in *Scientific American*, April 1996. The description of "nanotechnology" borders on pure science fiction - the stuff dreams are made of!

[12] *Popular Mechanics*, July 1909, quoted in James W. Canan, *War In Space*, Harper and Row, New York, 1982, 76.

[13] Basing on the moon, asteroids, or in stable orbits around the Lagrangian libration points, L4 or L5, are feasible and, in many cases, desirable if one takes the "high ground" argument to the extreme and ignores current prohibitions against using the lunar surface for military purposes. An interesting discussion on "gravity wells" and their military advantage is found in Harry Stine's book. He has eight other works, though slightly dated, that are worth review.

[14] *Scientific American*, April 1920, quoted in Canan, 96.

Chapter 4

Cost: Is Space Affordable?

If a nation values anything more than freedom, it will lose that freedom; and the irony of it is that if it is comfort or money that it values more, it will lose that, too.

—Somerset Maugham

Introduction

Most participants in the military roles, missions and force structure debate argue that cost is an even larger hurdle to moving military capability to space than technology. Without a significant Soviet nuclear threat, or any other single threat to our national survival, government focus has turned to solving domestic issues as its number one priority. As a result, defense spending has steadily declined[1] for 12 consecutive years and few would venture to speculate the trend will reverse any time soon.

From the military services' point of view, maintaining each of its own current force structure is paramount. Neither service has shown a willingness to voluntarily forfeit force structure in favor of another service or new and untested systems. Ships, submarines and airplanes will continue to be the centerpiece of US Navy planning, just as modern air superiority fighters and improved airlift will hold the place of honor in the Air Force's spending requests. Neither will the Army back away from its ten divisions,

theater missile defense nor its 21st Century Soldier modernization programs. Each service will continue to compete for funds in the new glamour missions—theater missile defense and information warfare. Therefore, it would appear obvious that increases in space spending will not come from existing budgets without drastic downward directed force structure changes. Some proposals for restructuring the military are presented later in this chapter, but first, a discussion on affordability is appropriate.

Affordability—A Matter of Choice

The argument that the United States cannot afford a large space investment is simply invalid. With an $8 trillion economy, this country can afford just about anything it chooses, and therein lies the key—choices. What the United States cannot bring itself to do is to make fundamental institutional choices that would allow it to take full advantage of the world's largest economy. For example, the $247 billion spent in fiscal year (FY) 1997[2] on interest on the five and a half trillion dollar government debt would more than adequately support a robust space investment program and several generous domestic spending packages without an increase in government income. The question is when will the country choose to make this money available to programs of more importance than government debt.

At a recent Air War College speaking engagement, an Air Force four star general made the point that the military can in fact afford to buy and employ three tactical fighters,[3] it just has to choose to become more efficient, delete spending in the appropriate areas, and use the money for the right programs. The same argument can be extended

to the country as a whole—increased space spending is not a question of affordability, but rather a matter of choice.

The same Congress who decided to reduce defense spending by $9 billion from FY96 to FY97 recently approved a $385 million family planning aid package to buy contraceptives and training programs for more than 100 overseas countries.[4] This is not a condemnation of foreign aid or abortion politics, but rather an example of budgetary choices this country is capable of making. Finally, the country has yet to raise protest over the military's choice to spend nearly $300 billion[5] to develop and acquire nine airplane systems over the next 10-20 years. Clearly, affordability is a matter of choice.

How Will the Air Force Choose?

In the likely event defense budgets continue to decrease, each service will be forced to relinquish force structure, both equipment and personnel. In this scenario, it is probable that space spending will come under tremendous pressure from Air Force leaders to decrease at an equal or greater pace than other Air Force programs. Many Air Force generals already believe space programs have taken dollars from the "blue" Air Force over the years and they will fight to maintain the air-breathing weapon systems they are most familiar with and, as a result, trust to maintain existing and planned capabilities.

Addressing the Air War College class in February, a senior Air Force general officer remarked that space spending now consumes 17% of the Air Force budget while the Air Force historical share of the total defense budget has remained constant. The facts were incorrect and the implication, of course, was that air-breathing programs have given up a share of their budget to space spending—a condition this general officer

clearly did not like and would no longer support in a declining budget environment. Should the current Chief of Staff attempt to maintain or increase space spending under these conditions, he surely would face tremendous pressure from the rest of the Air Force,[6] and such an attempt would most likely be short-lived. In spite of this probability, the following proposal outlines a space program that is both affordable and reasonable. It is not a scientific financial analysis, but it does lay out the thought process that must guide decision makers.

The $30 Billion Space Program

The United States will spend around $240 billion in FY97 to conduct air, land, sea and space operations. This money pays for people, weapons and munitions, research and development, modernization, fuel, intelligence, surveillance and reconnaissance (ISR), command and control (C^2), and transportation of people and material—all the things necessary to sustain a powerful military capability. At issue as the Air Force transitions from an air force to a space and air force is what portion of the defense budget should be allocated to space programs.

Current Space Spending

During FY96, "the US Air Force is investing $4.16 billion in space related activities. That's about $500 million less than what had been forecast for FY96 during the final year of the Bush Administration, but senior Air Force officials aren't complaining."[7] The reason they were not complaining, as indicated in previous chapters, is that the remaining $60 billion or so was sufficient to fund continued investment in air superiority and lift aircraft. Had a vote been taken among senior space community leaders, excluding those

pilots who currently occupy space leadership positions (see chapter 2), the response may well have been quite different. Four billion dollars[8] a year is simply not sufficient to support a meaningful transition program, and, since senior Air Force leaders would not, this paper will go on record as voicing the first complaint.

Table 6 shows Air Force spending for FY96-98, clearly indicating the Air Force has no intention of funding its transition program in the near term.

AF Space and Nuclear Activities ($ in millions)	FY96		FY97		FY98	
	$	%	$	%	$	%
Boosters	969.2	23.3	1014.6	23.4	1261.5	26.6
Milsatcom	858.8	20.6	1060.2	24.4	940.7	19.8
Warning	620.5	14.9	502.9	11.6	699.9	14.7
Ranges	405.7	9.8	377.1	8.7	381.3	8.0
Navigation	340.8	8.2	422.5	9.7	436.6	9.2
Space Surveillance	266.9	6.4	217.8	5.0	155.9	3.3
Satellite Control Net	213.0	5.1	208.9	4.8	251.6	5.3
ICBM Modernization	203.7	4.9	286.6	6.6	318.3	6.7
Other	166.2	4.0	117.5	2.7	108.5	2.3
Environmental Sensing	96.1	2.3	108.9	2.5	142.7	3.0
Strategic C^3	14.5	0.3	21.9	0.5	47.8	1.0
Nuclear Weapons	4.6	0.1	4.8	0.1	4.8	0.1
Total	4160.0	100	4343.7	100	4749.6	100

Source: Armed Forces Journal, September 1996

Figure 6. AF Space Spending

A clear signal of the Air Force's commitment to space would be the appearance of $3-5 billion new dollars annually until the year 2005 when spending levels should become constant at around $30-35 billion a year. That amount of Air Force spending on space programs would be sufficient to prepare it to complete its transition to a space and air force within the 2015-2025 time frame. A new national rationale is needed to justify this effort.

Rationale for Increased Space Spending

Today's National Security Strategy of Engagement and Enlargement commits US forces to global presence. As overseas physical presence shrinks, the only way to selectively engage whenever and wherever US forces are required is to simply pack up and go. This is not a cheap way to operate and the resulting high operations and personnel "tempo" is exacting a high price in readiness and retention.

Space-based forces offer the possibility to be constantly present and the ability to exert military influence over the entire globe. This "virtual presence" affords the same basic capability as existing forces, simply by employing a different basing philosophy. Space forces should be procured "in place of" not "in addition to" existing force structure.

Should the United States choose to exert influence with space-based systems, it could reduce its entire existing inventory based on this new national strategy. The military will find itself needing fewer stockpiles based in overseas locations, fewer planes, reduced lift from the sea and air, fewer people and fewer munitions, less fuel, and less money to support these reduced forces. By properly employing space-based force structure, the United States could maintain sufficient traditional forces to meet lower "boots on the ground" requirements while reducing troops and tanks, sailors and ships, airmen and airplanes. If the Air Force pursues its privatization efforts to the extreme, it could transfer nearly all its current space support operations to the commercial sector and use military space members only for specific military space functions. The obvious questions are how much could the nation reduce its existing forces and how would it allocate the remaining resources.

How to Divide the Pie

As noted earlier, this exercise is not an expert financial analysis, rather it is an attempt to generate thought and debate on the Air Force transition to a space and air force. The following estimates are presented in that vein solely to demonstrate the potential scope of what must be vigorous efforts to free existing dollars to finance increased space investment. Having sufficiently apologized to my own and sister services in advance, here are some proposals for offsets based on the above assumptions:

Fewer troops and tanks; reduce Army forces sufficiently to reduce overall Army spending by 10%, resulting in roughly $6 billion for space investment.

Fewer sailors and ships; reduce Navy and Marine forces sufficiently to reduce Naval spending by 15%, freeing approximately $11 billion annually.

Fewer airmen and airplanes; reduce Air Force force structure and spending by 20%, reallocating $13 billion for space spending.

Privatize existing space support functions; launch, satellite command and control, weather, navigation, most communications systems operations and most acquisition efforts can be accomplished by commercial and civil agents. The goal should be to save roughly $1 billion that could be redirected to purely military space activities.

These force reductions should be accomplished at the rate of 20% each year with funds reallocated to the Air Force budget and fenced for space investment. Investment programs should target those enabling technologies recommended in recent studies and reports such as New World Vistas, Spacecast 2020 and Air Force 2025. Operational concepts that meet joint requirements in Joint Vision 2010 and the Air Force's Global Engagement must be used as an approval template for all new starts. Finally,

recommendations in this paper for space doctrine and associated technology and education programs should be included in the new program debates.

Implementing the force restructure above will make significant resources available. The resulting total of $5-6 billion in new spending each year should be dedicated to space systems investment designed to increase the overall strength of American military power. This effort will begin the Air Force transition to the world's preeminent space force.

Summary

Significant increases in space spending are required to finance the Air Force transition to a space and air force. There are no near term increases in sight in new budget authority sufficient to pay for the investment needed to begin building a space force capable of achieving total global awareness, defending itself and performing warfighting functions accomplished by traditional terrestrial forces. Consequently, the military must reevaluate its current position on force investment, decide if it really wants to build a space force, and act to reallocate existing resources to new space programs.

Accepting the argument that space-based forces can perform many of the missions currently executed by existing air, land and sea forces will provide the rationale for new space investment to replace existing capability rather than add to it. Restructuring today's forces can result in $30 billion of new space investment funding.

Notes

[1] Tamar A. Mehuron, "The Defense Budget at a Glance," *Air Force Magazine*, May 1996, 12.

[2] Budget of the United States Government, US Government Printing Office, Washington DC, 1997, Table S-1, 303.

[3] Navy F-18, USAF F-22, and the Joint Strike Fighter.

Notes

[4] Katharine Q. Seelye, "Senate Easily Approves Family-Planning Aid Overseas," *New York Times*, 26 February 1997, n.p.; on-line, Internet, 26 February 1997, available from http://nytimes.com/yr/mo/day/news/washpol/senate-abortion.html.

[5] John A. Tirpak, "Snapshots of Force Modernization," *Air Force Magazine*, February 1997, 21-29.

[6] The three and four star generals who make up the senior Air Force leadership; mainly flyers.

[7] John G. Roos, "Beyond the Wild Blue," *Armed Forces Journal International*, September 1996, 12.

[8] In reality, it is extremely difficult to accurately show the funds allocated to space spending. Many agencies participate in space programs and analysts find it nearly impossible to capture all money spent on space. For example, some reports include funds administered by the Departments of Commerce, Transportation, Agriculture, Interior, and Energy, the National Science Foundation, the Environmental Protection Agency, and "others." Within the Department of Defense, all services spend money on space programs, both directly and indirectly. Intelligence agencies, the National Reconnaissance Organization and classified program content make it nearly impossible to account for all funds. Further, some programs that count in space totals are, arguably, not really space programs at all. Some analysts have difficulty including warning systems, C^2 programs such as Cheyenne Mountain, and ICBM programs in the space figures simply because they are administered by Air Force Space Command. Often, one encounters estimates differing by several billions of dollars, depending on who did the analysis and what definition they used to gather data. For instance, the Summer 1996 *Strategic Review* reports FY95 DOD space spending at $12.6B, while *Air Force Magazine* reports in August 1996 only $10.6B for the same year. The source used in this paper reports AF space spending at around $4B annually for FY96-98, but an AFSPC/XP briefing slide for the POM years FY98-03 shows AF space TOA at roughly $7B a year. It is doubtful that AF space TOA will grow by $3B from FY98 to FY99, although that is precisely what this paper argues should happen.

Chapter 5

Conclusions

Life is the art of drawing sufficient conclusions from insufficient premises.

—Samuel Butler
Notebooks[1]

The Air Force has committed to a bold new initiative—its transition from an air force to a space and air force. Several key issues must be addressed in order to create the right foundation which to launch this transition: space doctrine, space leadership, space related technologies and space spending.

Air force doctrine must be reshaped to recognize the uniqueness of the space operating medium. Study and understanding of the space environment must increase; space must be recognized as the fourth medium of warfare and a firm commitment to achieve space superiority must be made; space weapons, both offensive and defensive must be developed and deployed; space operators must be highly educated and trained; space leaders should be selected from space functional areas; and space must be exploited for its perspective, presence and responsiveness.

There is a severe shortage of Air Force general officers with experience in space operations. This condition must not be allowed to persist. The Air Force must commit now to a leader-development model similar to the one used so successfully to prepare future leaders of the flying Air Force for 50 years.

New enabling technologies must be pursued and existing technologies must be matured at a faster pace to prepare the nation to secure its place as the first and supreme military force in space. The first and foremost priority is ensured, affordable access to space, for all other space goals and objectives depend on "airplane-like" launch operations.

Finally, the nation must reevaluate its current position on space investment. The military community must accept the concept that overall military strength can be increased by deploying the appropriate forces in space. If the Air Force is serious about its transition, it will vigorously pursue a $30 billion annual increase in space spending.

Perhaps, as Carl Builder contends, only congressional or presidential direction can overcome internal Air Force inertia and produce the spending levels necessary to begin the transition to a space and air force. Increasing space spending to the recommended levels would force the Air Force to relinquish all but its airlift forces and only a few, perhaps as few as six to eight, wings of air superiority forces. Other traditional missions, such as interdiction, close air support, and defensive counterair, would transfer to other forces.[2]

The Air Force would take on the role of guaranteeing fast airlift, air, space and information superiority, missions it is well suited to perform, in support of other terrestrial forces. The Air Force made the commitment to transition to a space and air force out of concern for its future. It is time to begin the preparation for that future.

Notes

[1] I liked this example from the school-supplied template I decided to keep it. Thanks, Col Kelso.

Notes

[2] Navy, Marine, and Army air and deep strike forces; cruise missiles, conventional ICBM/SLBM, ground air defenses, and new space-based forces.

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